07.2-10 ATOMIC DISPLACEMENT IN HETERO-INTERFACE REGIONS OF $(GaAs)_{28}(AlAs)_{24}$ SUPERLATTICE LAYERS. By Y. Kashihara, T. Kase, J. Harada, Department of Applied Physics, Nagoya University, Japan.

The existence of the atomic displacement modulation in superlattices leads to asymmetry in the intensity distribution between + and − sides of the satellite reflections. By applying a method of Fourier analysis based on the asymmetry of satellite reflections the present authors (Jpn. J. Appl. Phys. 25 (1986) 1834) have shown that the lattice displacement modulation can be determined by using the satellite reflections observed around the 004 Bragg reflection of a MBE grown superlattice $(GaAs)_{28}(AlAs)_{24}$. In this paper we show that the Fourier analysis can be extended so as to determine cation and anion displacements independently, if the satellite reflections observed around two different type of fundamental Bragg reflections are included.

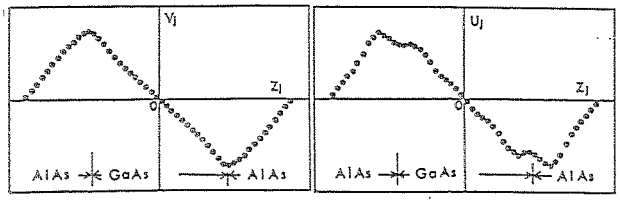
Within a framework of the kinematical diffraction theory and by making use of some approximation, the Fourier components C(q), U(q) and V(q) of the concentration modulation, C_j, and the cation and anion deviations, U_j and V_j, from their average positions Z_j are written as

$$C(q)\,\Delta f_c = (F_s(2+q)+F_s(2-q))/2 = (F_s(4+q)+F_s(4-q))/2,$$

$$2\langle f_c\rangle U(q) = (F_s(2+q)-F_s(2-q))/2iK_B^{(2)} + (F_s(4+q)-F_s(4-q))/2iK_B^{(4)},$$

$$-2f_{As}V(q) = (F_s(2+q)-F_s(2-q))/2iK_B^{(2)} - (F_s(4+q)-F(4-q))/2iK_B^{(4)},$$

where Δf_c is the difference of the two atomic scattering factors f_{Ga} and f_{Al}, $\langle f\rangle$ the average structure factor of cations, $F_s(M\pm q)$ the scattering amplitude of $\pm q$-th satellite reflection at the M-th fundamental Bragg reflection and K_B the scattering vector. Fig. 1 shows the displacement modulations, U_j and V_j, constructed from the observation of 28 satellite reflections around 002 and 004. In the GaAs region both U_j and V_j have a positive gradient while in the AlAs region both of them have a negative gradient. The inter-atomic spacing is, therefore, suggested to have a tendency to shrink in the GaAs region and to elongate in the AlAs region relative to the average spacing and that As atoms are always located at the mid-point between the nearest neighbor cations in the both regions. In the hetero-interface regions, however, a sharp change of the slope of V_j is noticed from a positive to a negative gradient while the change of U_j is rather smooth. This fact suggest that As atoms are not located at the mid-point between the nearest neighbor cations and they shift slightly to the Ga atom side at the hetero-interface regions.



07.2-11 HIGH RESOLUTION STUDY OF ROD-SHAPE X-RAY SCATTERING FROM THE (111) SILICON SURFACE. By N. Kashiwagura, Y. kashihara*, M. Sakata* and J. Harada*, Department of Basic Sciences, Faculty of Engineering, Gifu University, Japan, *Department of Applied Physics, Faculty of Engineering, Nagoya University, Japan

Intensity distribution of a rod-shape scattering (Kashiwagura, Harada and Ogino, J. Appl. Phys., 1983, 54, 2706, Andrews and Cowley, J. Phys. C, Solid State Phys., 1985, 18, 6427 and Robinson, Phys. Rev. B, 1986, 33, 3860) elongated exactly along the normal of a crystal surface through the 111 reciprocal lattice point was investigated for two (111) silicon wafers by using a high resolution x-ray spectrometer (4-circle diffractometer with a crystal analyzer and a Si 111 double crystal monochromator which is installed to the beam line 4 at photon factory of KEK). Surfaces of the samples were processed differently; one of them, sample MC, was mechano-chemically polished and the other, sample LE, was etched off by 30 μm after mechanical lapping. Fig. 1 shows the rocking curves of the rod-shape scattering centered on hhh reciprocal positions for the two samples, where $0.854 < h < 0.996$. The rod-shape scattering from the sample MC was found to elongate farther away from the zone center than that from the sample LE. The FWHMs for the sample MC do not change along the rod, while those for the sample LE gets broader and broader as q ($q=\sqrt{3}(h-1)$: deviation from the 111 reciprocal lattice point) increases. The slope of log I^{peak} vs. log q plot (I^{peak}: peak intensity of each rocking curve) was found to be 2.0 for the sample MC when q is in the regions of $-0.256 < q < -0.007$ and $0.007 < q < 0.052$. This is in agreement with the theoretical prediction for a perfectly flat surface. In the region of large q on the high angle side ($0.052 < q < 0.256$), however, the slope deviated from 2.0. The asymmetric intensity distribution between the low and high angle sides from the 111 reciprocal lattice point can be attributed to the atomic density and the lattice spacing at the surface.